

Writing Assignments in a Nonmajor Introductory Ecology Class

By Jack Tessier

The National Science Education Standards (NRC 1996) encourage teachers to increase the use of knowledge by students as opposed to simply asking students to memorize facts and concepts. Because writing helps to promote thinking and engagement in information (Rivard 1994; Keys et al. 1999; Steglich 2000), many teachers are promoting the use of writing assignments as learning (Moore 1994; Holliday, Yore, and Alverman 1994; Barlow 2003) and assessment tools (Hand and Prain 2002). Additionally, many teachers encourage the integration of disciplines to help students appreciate the complex nature of knowledge and understanding (Baker and Saul 1994; Glynn and Muth 1994; Holliday, Yore, and Alverman 1994; Taylor and Sobota 1998). The need for scientific literacy (Glynn and Muth 1994; Keys et al. 1999; Hand and Prain 2002) blends the above needs to encourage teachers to use writing to teach science, as well as to improve communication skills.

While writing has been used to help teach science for some time, there are a number of limitations in its current uses. For one thing, there is too much regurgitation-style writing (Keys 1999, 2000; Lester et al. 2003) where students create laboratory reports and other typically scientific formats (Rivard 1994; Holyoak 1998; Wallace 2004) with the teacher as the expected audience (Holliday, Yore, and Alverman 1994; Rivard 1994; Lester et al. 2003). Therefore, there is a need to provide writing assignments in science that vary the format and audience (Rivard 1994; Lester et al. 2003), with an emphasis on application rather than description (Rivard 2004), to encourage students to see the lifelong usefulness of scientific literacy

I developed writing assignments for an introductory ecology class to encourage nonmajors to improve their writing skills and gain an appreciation for environmental issues. Statistical analyses suggest that during the semester, students' writing skills, their ability to write accurately about the environment, and their environmental behavior all improved.



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FIGURE 1**Writing assignments given to nonmajor students in an introductory ecology course.****Taxol case study**

The case study regarding Taxol raises important and difficult questions about human health and the use of ecological resources. Your assignment is to describe the issues from all sides and explain what you think is the most appropriate course of action. Consider all that you have learned about ecosystems and your personal experiences with health issues. Write your response so that your parents can understand what you write; that is to say, do not be technical in your language. Write for an audience without the education that you have already acquired in this course. Limit your response to two pages or less. Use the grading rubric to guide your work.

Letter to the editor

The environment is constantly in the news. Pick a news story relating to the environment that interests you. Write a letter to the editor indicating what you feel is the appropriate action for citizens and the government to take in response to this news event. Use your textbook and other resources (internet, newspapers, magazines, scientific journals, etc.) to provide an educated recommendation. Limit your response to two double-spaced, typed pages. Include the address or website through which you can submit your letter to the paper of your choice. Use the examples on the back of this page as a guide (although you should speak more to the environmental facets of the issue instead of the business facets as these authors have done).

Natural history essay

Write an essay that describes an aspect of natural history in one of the two following contexts. One: Visit a natural area or think back to a natural area that has been important to your life. Describe an aspect of that area that has influenced you and explain why it is important to your life. Two: Observe a site that represents what you feel is a misuse of the environment, such as a dumpsite or an area that has been cleared of forest to build a mansion (these are just possible examples, you should choose a site that you feel is a problem). Explain why you feel the current use is inappropriate and provide directions for improving the situation. Give an educated recommendation. Regardless of which essay option you choose, limit your essay to two double-spaced, typed pages. Use the example on the back of this page as an example.

Letter to Congress

Your congressional representatives make decisions nearly every day that affect the environment (and thereby your health and your children's future world). Decide what you feel is the most important environmental issue facing us today. It can be a specific issue (such as industrial and auto emissions) or an inclusive issue (such as the human population crisis). Write a letter to your elected officials in the U.S. Congress. Explain to them why you feel that this issue is the most important one and give them an educated recommendation regarding what should be done to solve the problem. Limit your letter to two double-spaced, typed pages. Include the addresses or websites you can use to send your letter to Congress.

and to promote their understanding of the connectedness of scientific issues to other components of their lives. Additionally, there is a need for more classroom-style research into the effectiveness of writing assignments in helping students learn and develop their writing skills (Glynn and Muth 1994; Rivard 1994).

To address some of these needs, I developed writing assignments for a nonmajor introductory ecology course that required students to write for a range of audiences and to think more deeply about topics raised in class. The objective of this study was to determine the effectiveness of writing assignments in improving students' writing skills and their knowledge of and appreciation for environmental issues.

Methods

Introductory Ecology (Bio 132) is a nonmajor biology class that meets requirements for general education at Central Connecticut State University. The course deals with basic ecology concepts, such as population dynamics and ecosystem function, and then covers a variety of environmental science issues, such as the human

population, pollution, and energy sources. It typically has an enrollment of 30 to 40 students per class and I have taught it in the past using lectures and discussions and assessed student learning with objective tests.

During the spring semester of 2004, I evaluated the use of writing assignments to (1) improve students' writing skills, and (2) increase their understanding of and appreciation for environmental issues. The as-

FIGURE 2

Grading rubric used to assess performance on short writing assignments in a nonmajor introductory ecology course.

Content

All important issues presented and assignment meets requirements	20
One missing issue or unmet requirement	15
Two or more missing issues or unmet requirements	10

Accuracy

Completely accurate	30
One inaccurate statement	25
Two to three inaccurate statements	20
Four or more inaccurate statements	15

Style

All statements smooth and comprehensible	20
One statement difficult to understand	15
Two or more statements difficult to understand	10

Grammar and Spelling

No grammar or spelling errors	20
One grammar or spelling error	15
Two to three grammar or spelling errors	10
Four or more grammar or spelling errors	5

Timeliness

Handed in during class on due date	10
Handed in after due date	0

TABLE 1

ANOVA results associated with the change in quality of student writing submissions during the semester in a nonmajor introductory ecology class.

Rubric Category	Degrees of Freedom	F-value	p-value
Content	37	12.96	<0.0001
Accuracy	37	5.46	0.017
Style	37	11.54	<0.0001
Grammar and Spelling	37	5.78	0.0012
Timeliness	37	1.73	0.1660

signments required students to write for a variety of audiences including their parents, peers, and congressional representatives (Figure 1). The topics students wrote about were taken from recent issues of a local newspaper.

I used a rubric to assess each of the writing assignments (Figure 2). Using a standard measure allowed me to determine how the assignments were affecting students' writing skills over time. Because rewriting is important to improving writing skills (Moore 1994; Holliday, Yore, and Alverman 1994; Havel 1995; Hand and Prain 2002; Kokkala and Gessell 2002), I allowed students to perform rewrites to improve their grades on each assignment. I used a one-way analysis of variance within each rubric category, treating each student as a block, to determine if there was a difference in student performance on their original submission among the writing assignments and therefore over the course of the semester.

In addition to the periodic, short writing assignments, students divided themselves into groups at the start of the semester and chose an environmental topic in which they were interested and that they felt was important. At the end of the semester, each group gave a 15-minute presentation and produced a 10-page group report on the topic. This assignment provided additional writing practice for students and was graded using a rubric similar to that used with the shorter writing assignments.

To assess how the writing assignment affected students' attitudes and understanding of environmental issues, I gave a presemester survey on the first day of class and repeated the same survey at the end of the semester (Figure 3). In order to quantify the survey results, I

converted the responses into numerical values, equating "disagree strongly" with 0 and "agree strongly" with 5, graduating the intermediate responses evenly. I used a paired t-test for each question of the pre- and postsemester survey to determine if there was a change in students' attitudes about the environment from the beginning of the semester to the end. Differences in both statistical tests were assessed with $\alpha = 0.05$. Finally, I conducted a midsemester course evaluation to assess student opinions about the writing assignments and class in general. While this evaluation did not assess improvement in the students' writing ability, it served as a means to judge the continued utility of the course design. If students were wholeheartedly against the use of writing assignments, then their satisfaction with the course and therefore their motivation to learn would be diminished and using writing assignments would not be a viable option.

Results

The accuracy with which students wrote about the environment and their

writing skills improved through the semester (Table 1 and Figure 4). By the end of the semester, students were committing fewer errors of fact than they were at the start of the semester. They were also making fewer spelling and grammatical mistakes and writing fewer awkward and confusing sentences by the end of the semester. There were no significant changes in students' ability to meet the requirements of the assignments (with the exception of assignment two) and to turn in their assignments on time throughout the semester.

There was an increase in students' behaviors relating to their attitudes about the environment (Table 2 and Figure 5). While there was not a change in the relative concern that students felt about the environment, the students reported that they increased the number of actions they took on behalf of those concerns.

Discussion

The use of writing assignments and a semester-long report improved students' writing skills and increased their

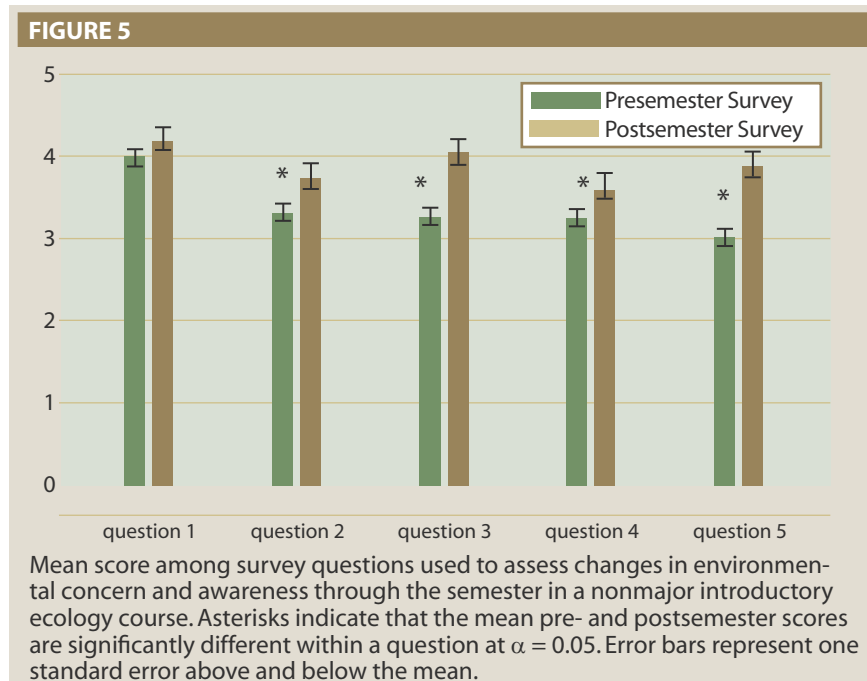
FIGURE 3

Pre- and postsemester survey used to assess changes in environmental concern and behavior of nonmajor students in an introductory ecology course.

1. I am concerned about the environment.	Disagree strongly	Disagree	Neutral	Agree	Agree strongly
2. I consciously limit my environmental impact.	Disagree strongly	Disagree	Neutral	Agree	Agree strongly
3. I encourage others to consider their environmental impact.	Disagree strongly	Disagree	Neutral	Agree	Agree strongly
4. I pay attention to news stories about the environment.	Disagree strongly	Disagree	Neutral	Agree	Agree strongly
5. The environment is an important consideration when I vote.	Disagree strongly	Disagree	Neutral	Agree	Agree strongly

knowledge of and ability to communicate about the environment (Figure 4). Students were consistently able to meet the requirements of the assignments and to keep their content grade high. The exception was the second assignment, on which many students failed to include an address to which they could submit their letter to the editor. The number of factual errors in assignments decreased through the semester, indicating that students improved their ability to locate and accurately report facts about the environment. As students' writing style improved and their grammatical and spelling mistakes decreased throughout the semester, students were clearly able to improve their writing skills based on what they learned by completing and revising the assignments. This approach therefore integrated language skills and scientific knowledge in a successful way (Baker and Saul 1994; Glynn and Muth 1994; Holliday, Yore, and Alverman 1994; Taylor and Sobota 1998).

Students gained an appreciation for what they can do to help the environment during the course (Figure 5). Being "concerned about the environment" can have multiple interpretations, and this vagueness may have contributed to the lack of a change in student responses to the first survey question. While students did not change in the degree to which they are concerned about the en-



vironment, they collectively increased the level at which they limit their environmental impact, encourage others to consider their own environmental impact, pay attention to environmental news stories, and consider the environment when they vote. Certainly, while students entered the course thinking that they cared about the environment, they did not have enough knowledge of their own effects on the environment to act on those concerns. The deep understanding that they acquired by completing the writing assignments and the report provided them with the tools that they

needed to understand their role in the Earth's ecosystems and how they can ameliorate their influence on those ecosystems. The increase in the attention that students pay to environmental news indicates an improvement in their functional scientific literacy (Glynn and Muth 1994; Keys et al. 1999; Hand and Prain 2002), which will serve them well. Additionally, the increase in students' consideration of the environment when they vote is encouraging, because this awareness may cause more students to be politically active and engaged.

Students overwhelmingly approved of the use of writing assignments. Of the 34 students who completed the midsemester evaluation, 30 preferred writing assignments to tests, while only three indicated that they preferred tests. One student was unsure. Several students indicated on the midterm evaluation that they preferred writing assignments to tests because they learned while they completed the assignments (Rivard 1994; Keys et al. 1999; Steglich 2000) instead of cramming to learn quickly forgotten facts for an exam. Many students stated that the writing assignments were less anxiety-producing than tests and increased their understanding of the material beyond what studying for an exam would accomplish because they were using their knowledge instead of simply repeating their knowledge.

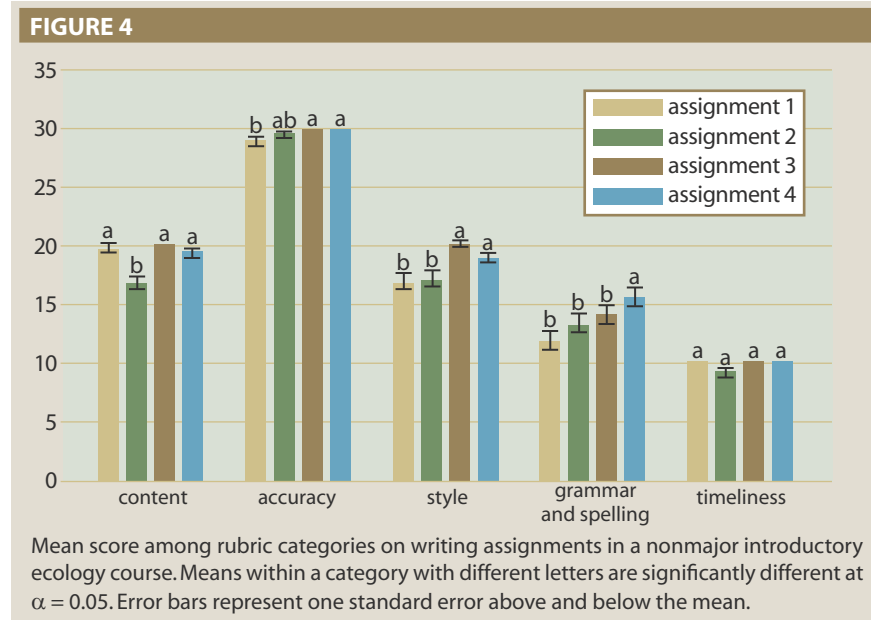


TABLE 2

Paired t-test results comparing responses to a pre- and post-semester survey given to students in a nonmajor introductory ecology classroom (see Figure 3 for questions).

Question	Degrees of Freedom	t-value	p-value
1	39	1.87	0.1826
2	39	7.36	0.0114
3	39	23.07	<0.0001
4	39	5.64	0.0249
5	39	54.00	<0.0001

These reactions are exactly the types of responses that move science education toward the teaching standards of the National Science Education Standards (NRC 1996) and will help to get more young Americans interested and engaged in science rather than fearful of it (Baker and Saul 1994).

In the future I plan to be more precise in the level of detail that I expect in the writing assignments. This change will encourage students to become even more engaged in the topics and to further promote their understanding of and appreciation for the environmental issues under consideration.

In conclusion, the writing assignments used in this course effectively integrated writing skills and science. These assignments required students to use knowledge that they gained in class and to access new knowledge from additional sources to address issues important to their lives and communicate that understanding effectively under authentic scenarios. Students' knowledge of and appreciation for the environment, along with their writing skills, improved throughout the semester. Students approved of the use of writing assignments and displayed an appreciation for the effectiveness of the writing assignments in helping them learn and display their understanding. ■

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